Washington State
Department of Transportation

Memorandum

December 15, 2005

TO: T.A. Suing /A.D. Byrd
South Central Region
Union Gap, Washignton

FROM: T. M. Allen/ S. Tayeh
EESC Geotechnical Branch, 47365

SUBJECT: SR-12 XL-2134
Attalia Vicinity Four Laning Bridge 12/606 Widening
Geotechnical Report

Attached with this memorandum is the geotechnical report for the design and construction of the Attalia Vicinity Four Laning Bridge 12/606 Widening and the associated walls, embankment, and retaining walls. This report addresses the following.

- Site geology
- Seismicity
- Subsurface conditions
- Foundation recommendations
- Construction considerations

If you have questions or require further information, please contact Sa'ud Tayeh at (360) 709-5416.

TMA:sat

SAT

Attachment

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GEOTECHNICAL REPORT

SR-12

Attalia Vicinity Four Laning Bridge 12/606 Widening

XL-2134

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12/15/5

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December 15, 2005

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1 INTRODUCTION

1.1 General

This report presents the results of our geotechnical investigation of the SR-12 BN & UP Rail Road over crossing (OC) Bridge 12/606 widening project. A vicinity map showing the project location is shown as Figure 1, Appendix A. This report provides information and recommendations for the bridge foundation only. When the PS&E is completed for this project, our office will provide the *Summary of Geotechnical Conditions* for inclusion in the Special Provisions.

The analyses, conclusions, and recommendations provided in this report are based on the project description, and site conditions existing at the time of the field explorations. The exploratory borings are assumed to be representative of the subsurface conditions throughout the project area. If during construction, subsurface conditions differ from those described in the explorations, we should be advised immediately so that we may reevaluate our recommendations and provide assistance.

1.2 Project Description

This project will construct a new 2-lane, 38-foot wide bridge to the west side of the existing SR-12 OC Bridge 12/606. The existing bridge is a five span precast girder bridge. The proposed bridge will be a three span post tension (PT) or precast girder bridge. Fill will be needed to accommodate widening along the west side of the approaches.

The widening will be constructed on approximately 35 to 50 feet of loose to very dense sand with gravel, which overlies basalt.

2 PROJECT SUBSURFACE CONDITIONS

Subsurface conditions in the project area were explored by rotary drilling, standard penetrometer testing, and a laboratory-testing program. Appendix C provides a detailed discussion and all test hole data obtained in the field exploration program. Please note that the edited logs of the test borings should be made available to all prospective bidders, and included in the contract documents. Appendix D provides a discussion and all data obtained in the laboratory-testing program.

2.1 Regional Geology And Seismicity

The project site is located in the Pasco basin situated east of the Southern Cascade Range. Recent basin development occurred with the deposition of sedimentary deposits. These sand, silt and gravel deposits are thought to come from two possible sources, the Spokane floods or glacial outwash deposits from the Cascade Range. Under the young sedimentary deposits are layers of (Miocene) flood basalts. The basalts are the result of flows from the Grande Ronde volcano near the Southeast corner of Washington.

Soil beneath the project site includes sand, silt and gravel. The topsoil layer, loose to medium dense sand, appears to be either recent alluvium deposits or glacial recessional deposits. The project area is in an inactive seismic zone. No earthquakes in recent history have been recorded.

2.2 SITE SURFACE CONDITIONS

The topography is generally flat to gently rolling hills. Large undeveloped properties occupy the area surrounding the B.N. & U.P. railroad tracks that the bridge crosses. Vegetation in the area is sparse and consists of junipers and shrubs. Surficial soils in the area are composed of sands and poorly graded sands. A site plan illustrating the locations of test holes and surface features is provided in Appendix A, Figure 2.

2.3 SITE SOIL CONDITIONS

Four test borings designated as H-1-05, H-2-05, H-3-05, and H-4-05 were performed to characterize the subsurface conditions at the project site. A site plan illustrating the locations of test holes and surface features is provided in Appendix A, Figure 2.

The soil deposits encountered in the test borings at the project site have been grouped into three soil units for geotechnical distinction. The soil units are grouped primarily on the basis of engineering properties and classification, and in general, reflect depositional environments as well. Subsurface profiles for the proposed structure illustrating subsurface data and the interpreted conditions are provided in Appendix A, Figure 3.

Unit 1 is alluvium deposits consisting of loose to medium dense silty sand to silt with sand, brown, dry to moist.

Unit 2 is a glacial recessional deposit consists of dense to very dense silty sand to poorly graded sand with interbedded layers of well graded gravel with sand, brown, moist to wet.

Unit 3 consists of strong, fine-grained basalt with closely spaced discontinuities.

2.4 GROUND WATER

Ground water is present at various depths within the project limits. The static water level in the project vicinity is dependent upon seasonal variation in precipitation. In general, groundwater was encountered at various depths at the time of drilling during March and April of 2005, as shown in the following table:

Boring Hole	Groundwater depth (feet)	
	Depth	Elevation
H-1-05	32	333
H-2-05	21.5	343.5
H-3-05	23.5	341.7
H-4-05	20	356

2.5 Design Earthquake Parameters

For seismic design, an acceleration coefficient of 0.10g is recommended in accordance with the Geotechnical Design Manual (GDM). The recommended acceleration coefficient is based on expected ground motion at the project site that has a 10 percent probability of exceedance in a 50-year period.

Design response spectra presented in the AASHTO guide specifications for seismic design of highway bridges are considered appropriate for seismic design of the structures on this project. A Type II soil profile response spectrum, with a site coefficient of 1.0, is recommended for seismic design.

2.6 Liquefaction Potential

Liquefaction of saturated sands occurs when the sands are subjected to cyclic loading. The cyclic loading causes the sudden increase of pore water pressure in the sand, thus reducing the intergranular stresses. As the intergranular stresses are reduced, the shearing resistance of the sand decreases. If pore pressures develop to the point where the effective stresses acting between the grains become zero, the soil will behave like a viscous fluid. Under this condition soil flow is possible. The effect of liquefaction can range from reduced shear strength to viscous fluid behavior.

The liquefaction potential of saturated sands is evaluated mainly on soil gradation, relative density, and the depth of the deposit. The potential for liquefaction is highest for loose, fine to medium grained sands with fine content less than about 25 percent.

We have evaluated the potential for liquefaction of the project soils based on the SPT data obtained from the field explorations and the percentages of silt. Our analysis indicates that the potential for liquefaction is low.

3 GEOTECHNICAL RECOMMENDATIONS

3.1 Approach Embankments

3.1.1 Approach Embankment Geometry

According to the plans for the proposed embankment, the proposed embankment will be a maximum of 50 feet wide (shoulder to shoulder) and 38 feet high. The final side slopes of the embankment will be 2:1 or flatter. According to preliminary bridge plans provided by Bridge and Structures office, the abutment and curtain walls will have a maximum vertical height of approximately 34 feet. Retaining walls 16 feet in vertical height will meet the curtain walls to retain the approach fill.

3.1.2 Approach Embankment Stability

The stability of the embankment under existing and proposed conditions was evaluated at H-1-05 in the vicinity of station Sta. 307+00. Approach embankment widening is planned for both north and south ends of the bridge, but after evaluating the cross-sections and subsurface explorations, we concluded that station 307+00 is the most critical design section and was used to evaluate the approach embankment stability for both the north and south bridge approach embankments.

The new fill will be generally placed, in sections, atop the existing embankment, which contains medium dense silty sand and gravel, and atop the native soils which contain loose to medium dense poorly to well graded sand. We estimate as much as 1 inch of settlement will occur under the embankment at pier 4 due to placement of the new fill. Settlement should occur as loads are placed. Post construction settlement is expected to be minimal.

However, we estimate as much as 4.0 inches of settlement will occur at pier 1 under the approach embankment due to placement of the new fill and pier 1 spread footing. Therefore, we recommend that subsurface ground improvement described in **Section 3.3.2** of this report be followed.

All final slopes on the north and south approach embankments should be 2H:1V or flatter. Select Borrow can be used for the embankment in favorable dry weather conditions. Gravel Borrow should be used if wet weather construction is likely. All approach embankment materials should be compacted using compaction Method C per the Standard Specifications.

3.2 Bridge Approach Slabs

The Design Manual Section 1120.03(6) requires all bridges to have approach slabs unless approval for their deletion has been given. Due to the height of the embankment, we recommend that approach slabs be constructed at the both abutments.

3.3 Foundation Recommendations

We have evaluated the following foundation options for all of the piers: spread footing, driven piles and shafts.

The risk of significant settlement of the bridge foundation will be a concern at the pier 1 site. However, the settlement can be controlled, through our subsurface improvement recommendation in **Section 3.2.2** of this report. Based on discussions with the Bridge and Structures office a footing will be the most cost effective option for the abutment piers (pier 1 and 4). Therefore, we recommend that spread footings support the abutments (piers 1 and 4).

However, for piers 2 and 3 spread footings will not be adequate due to the fact that the structures require a relatively high bearing capacity and the close proximity to the rail road tracks. Driven piles are feasible from a geotechnical standpoint. However, due to vibration that may affect the existing railroad tracks and the relatively shallow dense to very dense subsurface soil, we feel that piles will not be easily installed. Therefore, we recommend that drilled shaft foundation support be used for piers 2 and 3.

3.3.1 Shaft Foundations (Interior Piers)

It is expected that shafts will require less excavation and be easier to construct under train traffic in the constricted space.

Attached are the ultimate skin friction and ultimate end bearing figures for 8-foot diameter shafts (See Figures 6 & 7). If other shaft sizes are needed for structural reasons, please contact this office for additional ultimate skin friction and ultimate end bearing figures.

At a given depth on the figures, the factored resistance (Q′) can be determined by adding the ultimate skin friction (Q_s) multiplied by its resistance factor (ϕ_s) and the ultimate end bearing (Q_b) multiplied by its resistance factor (ϕ_b) as shown in the following equation:

$$Q' = Q_s \cdot \phi_s + Q_b \cdot \phi_b$$

For the service limit state, the settlement of the shaft foundations will be less than 1-inch provided the shafts are at or below the minimum tip elevation of 327 and 324 feet for piers 2 and 3, respectively. Settlement will occur as the loads are applied. Post construction settlement should be negligible. Service limit state bearing curves are provided in Figures 6 and 7.

3.3.1.1 Resistance Factors for Drilled Shaft Design

We recommend that the following resistance factors be used when evaluating the different limit states.

	Resistance Factor ϕ		
Limit State	**Skin Friction, Qs**	**End Bearing, Qb**	**Uplift**
Strength	0.55	0.50	0.45
Service	1.00	1.00	N/A
Extreme	1.00	1.00	0.80

Due to the presence of loose to medium dense soils and ground water, we anticipate that the wet method of construction will be used. To prevent soil caving, temporary casing should be required to the following elevations:

Pier	Elevation (Feet)
2	338
3	340

3.3.1.2 Potential for Downdrag

Based on our review of all available data at this time, we believe the potential for downdrag is acceptably small, and downdrag loads can be neglected for the interior piers.

3.3.1.3 Lateral Load Analysis

Based on our review, Soil conditions on the site cannot be readily correlated to the standard soil profiles in the *Design Manual for Foundation Stiffnesses Under Seismic Loading*. For this reason, S-Shaft and P-y parameters are attached.

3.3.1.4 Group Reduction Factors

For lateral analysis of foundation elements in a group, reduction factors should be used if P-y methods of analysis are used. The values of P should be multiplied by the values, P_m, in Table 3.3.1.4 to modify the P-y curves used in the analysis. The multipliers, P_m, in Table 3.3.1.4 are a function of the center-to-center spacing expressed in multiples of the foundation element diameter (D) as measured along the direction of loading within the group. The values of P_m in Table 3.3.1.4 were developed for vertical elements only. Note that P_m is not applicable if strain wedge theory is used.

Table 3.3.1.4. Load Modifiers, P_m, for Multiple Row Shading (averaged from Hannigan, et al., 1997).

Center-to-Center spacing in the direction of loading	Load Modifiers, P_m		
	Row 1	Row 2	Row 3 and higher
3D	0.70	0.50	0.35
5D	1.00	0.85	0.70

Loading direction and spacing for group effects are as defined in Figure 8-27 of the GDM.

3.3.2 Abutment Foundation Recommendations

Enclosed are ultimate capacity charts for strength, service and extreme event limit states. Figure 4 is for Pier 1 where the spread footing is in the embankment fill, and Figure 5 is for Pier 4 where the spread footing is on native ground. The capacities shown on the plots are based on the effective foundation widths.

Figure 4 for Pier 1 assumes the approach embankment subgrade be overexcavated down to an approximate elevation of 356 feet. Place the excavated materials back, using standard specification 2-03.3(14) and Compaction Method C. Any unsuitable soil materials that may be encountered should be removed and replaced with Gravel Borrow per standard specification 9-03.14(1). A typical over excavation detail is included in Appendix A, Figure 8.

We recommend the settlement of the spread footing be monitored during construction. A survey monument should be placed on the toe of the Pier 1 spread footing immediately after the footing is poured (before construction of the abutment wall). The elevation of the monument should be measured to within 0.01 feet at the completion of each major portion of the bridge construction (footing, abutment wall, girders, bridge deck, and backfill of abutment). A riser pipe may be necessary if the footing is backfilled prior to completion of bridge construction. Since this bridge has large approach embankments, we recommend a benchmark be selected that is well away from any construction activity.

For the service limit state, the figures contain a curve of ultimate capacity at a given settlement (1-inch) as a function of effective foundation width. At both piers, the settlement should occur as the loads are applied. Post construction settlement should be negligible.

For passive pressure resistance at the foundation toe and active pressure acting on the abutments, the following soil properties should be used to estimate the forces:

Parameter	Value
Unit Weight (γ)	130 pcf
Soil Friction (ϕ_f)	36°
Active Earth Pressure (k_a)	0.23
Passive Earth Pressure (k_p)	4
Coefficient of Sliding ($\tan \phi_f$)	0.72
Seismic Earth Pressure Coeff.	0.09
At Rest Earth Pressure (k_o)	0.4

3.3.3 Resistance Factors for Spread Footing Design (Pier 1 & 4)

We recommend that the following resistance factors, be used when evaluating the different limit states.

Limit State	Resistance Factor ϕ		
	Bearing	Shear Resistance to Sliding	Passive Pressure Resistance to Sliding
Strength	0.45	0.80	0.50
Service	1.00	n/a	n/a
Extreme	1.00	0.90	0.90

3.3.4 Soil Springs for Spread Footing Foundation:

We recommended that equivalent spring constants for the spread footing foundation be determined by the method outlined in section 7.2.4 of FHWA Report No. FHWA-IP-87-6 entitled: Seismic Design and Retrofit for Highway Bridges. The shear modulus and Poisson's ratio of the foundation soil must be estimated to calculate the equivalent spring constant using this method.

Based on the results of our analysis, we have developed a range of shear modulus values for the soil unit under these spread-footing foundations. The most critical spring constant for the pier support depends on the rigidity of the superstructure. This is determined by the structural engineer. We are providing a range of shear modulus values so that you may decide which is more critical, a weak or stiff spring. Our recommended soil parameters for spring constant determination are as follows:

Pier location	Shear Modulus*	Poisson's ratio μ
Piers 1 & 4	640 ksf to 1900 ksf	0.4

*Shear modulus is for strain magnitudes expected for strong motion earthquakes between 0.2 to 0.02 percent strain, respectively.

3.4 RETAINING WALLS

According to plans and data provided by Bridge and Structures Office, the new bridge has two abutments walls, four curtain walls, and four retaining walls. All of these walls will be constructed to support the new bridge and to retain compacted approach fill.

3.4.1 Retaining Wall A, B, C and D

Retaining walls A and B will be at the north abutment and retaining walls C and D will be at the south abutment. All of the walls are similar in both geometry and application. The maximum height of the proposed retaining walls will be approximately 16 feet.

After a discussion with both the Region and the Bridge and Structures Offices, we understand that standard plan geosynthetic walls are preferred at this time. Wall Type 4 shown in Standard Plan D-3 provides adequate reinforcing length to meet the required factors of safety for bearing capacity, sliding, overturning, and global stability. Wall settlements are anticipated to be 2 to 3 inches depending on wall height. After construction, the walls should be allowed to settle for 14 days, before the concrete fascia is constructed.

A traffic surcharge of 250 psf should be added when designing the wall.

The following table shows the recommended parameters for the curtain walls:

Fill Unit Weight (pcf)	**Friction Angle Φ (deg)**	**Ko**	**Ka**	**ΔKae**	**Kp**
130	36	0.41	0.23	0.09	11.15

Our analysis of the abutment and retaining walls under seismic conditions indicates that these walls will be stable.

4 CONSTRUCTION CONSIDERATIONS

Temporary shoring may be needed to preserve the existing adjacent roadway at the abutments. A temporary slope of 1H:1V can be used for shoring and excavation estimating purposes. We expect hard driving conditions in the embankment fill areas. Shallow groundwater may be encountered at various elevations between 333 feet to 456 feet. Please note that the determination of the actual slope used for the temporary excavation and/or shoring method and type are the responsibility of the contractor.

During shaft construction, loose caving sands and groundwater will be encountered during drilling. The wet method of construction should be anticipated. Temporary casing should be required to prevent ground caving in the Unit 1 soils, as specified in section 3.3.1.1 of this report.

The contractor should be prepared to use casing, slurry, or other methods to keep the shaft excavation open.

APPENDIX A

FIGURES

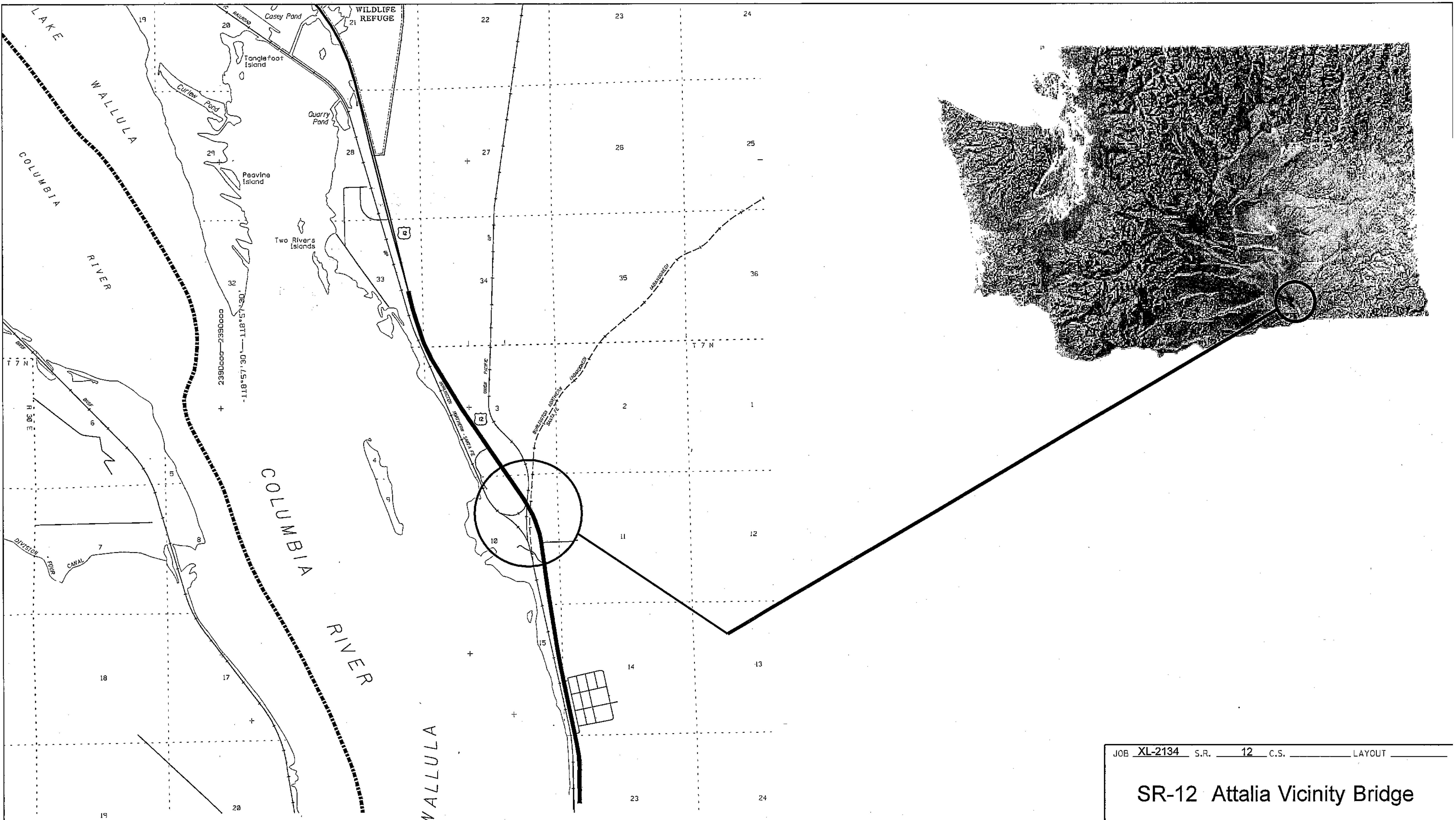

Figure 1: Vicinity Map

JOB XL-2134 S.R. 12 C.S. ______ LAYOUT ______

SR-12 Attalia Vicinity Bridge

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION

MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 4/05
SCALE NOT TO SCALE VERT. HORIZ.
SHEET ___ OF ___
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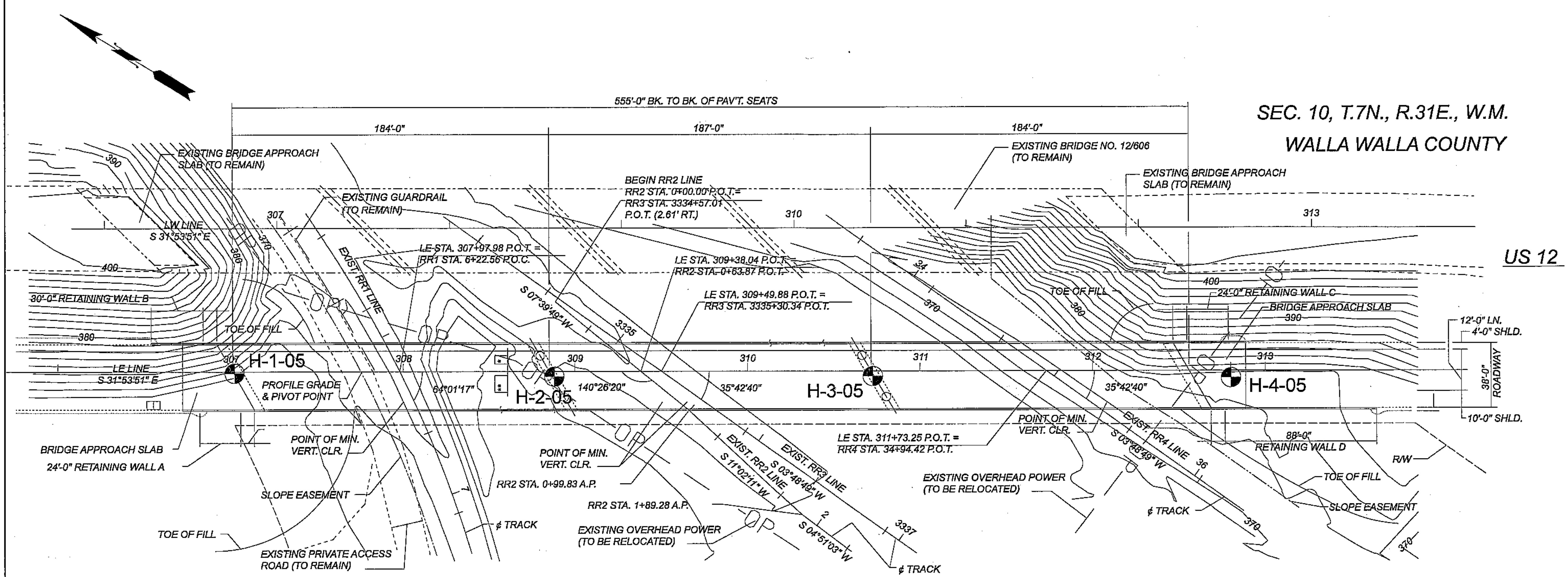

Figure 2: Site and Exploration Plan

JOB XL-2134 S.R. 12 C.S. LAYOUT	
SR-12 Attalia Vicinity Bridge	
WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION MATERIALS BRANCH T. E. BAKER MATERIALS ENGINEER	DATE 4/05 SCALE 1"=60' VERT. 1"=60' HORIZ. SHEET ___ OF ___ DRAWN BY DWG

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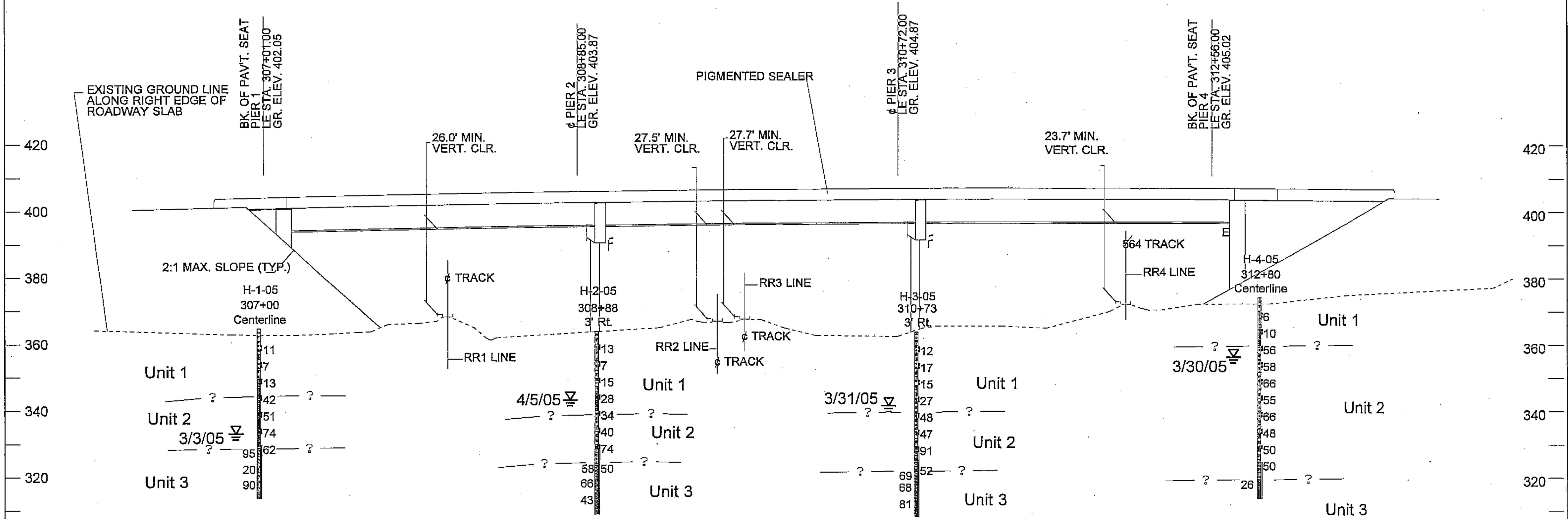

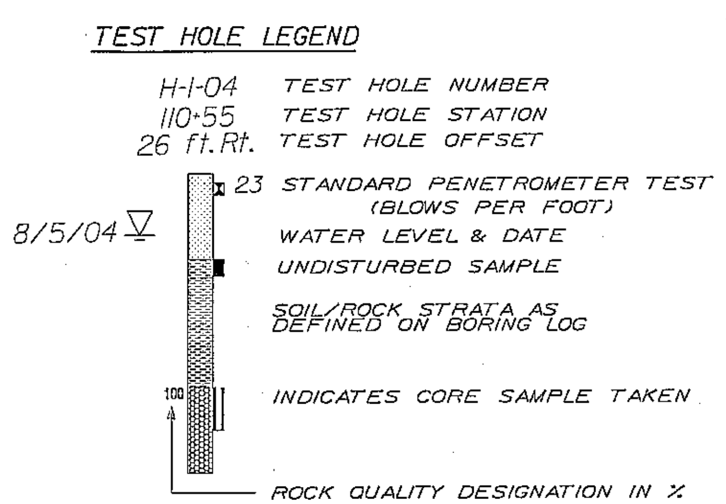

Unit 1: Loose to medium dense, silty SAND to SILT with sand

Unit 2: Dense to very dense, silty SAND to poorly graded SAND with interbedded layers of well graded GRAVEL with sand

Unit 3: Strong BASALT with closely spaced discontinuities.

JOB XL-2134 S.R. 12 C.S. ______ LAYOUT ______

SR-12 Attalia Vicinity Bridge

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 4/05
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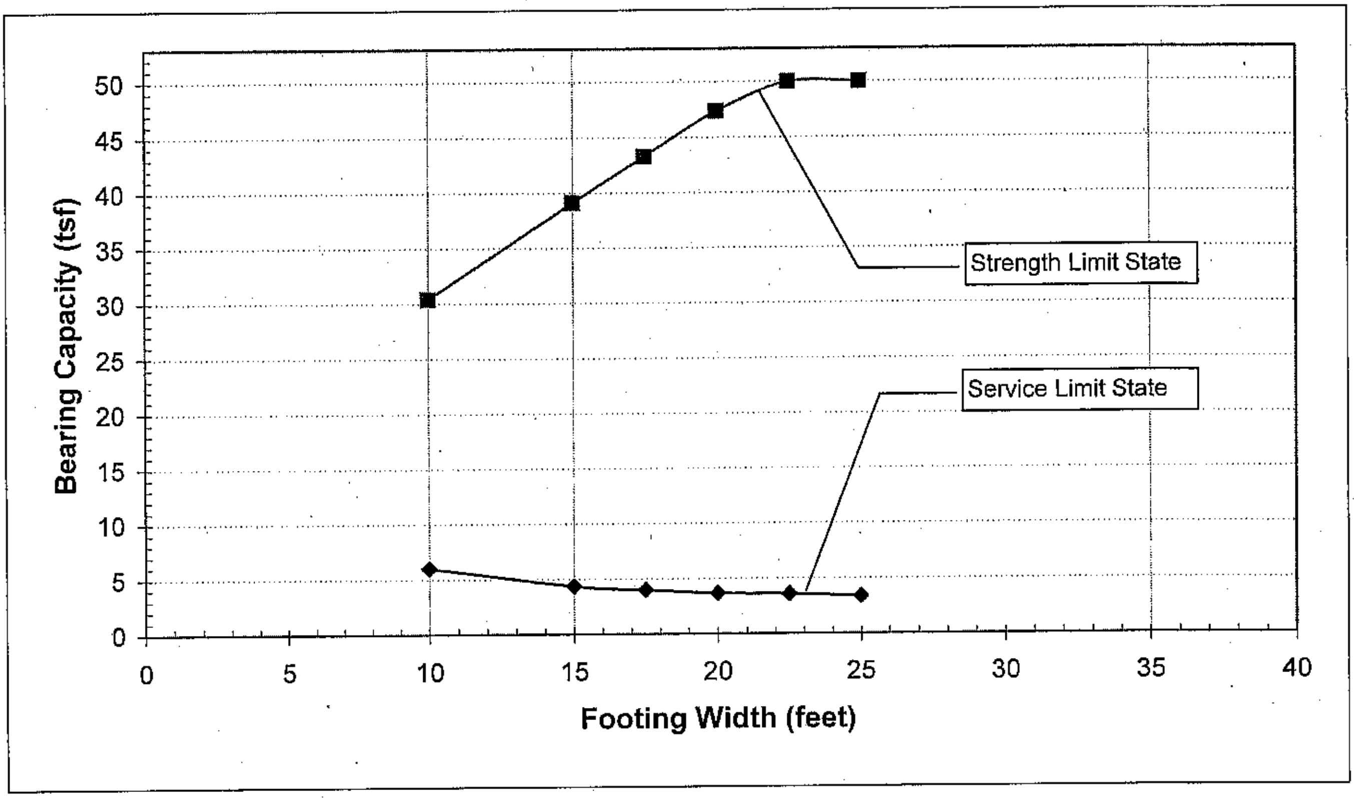
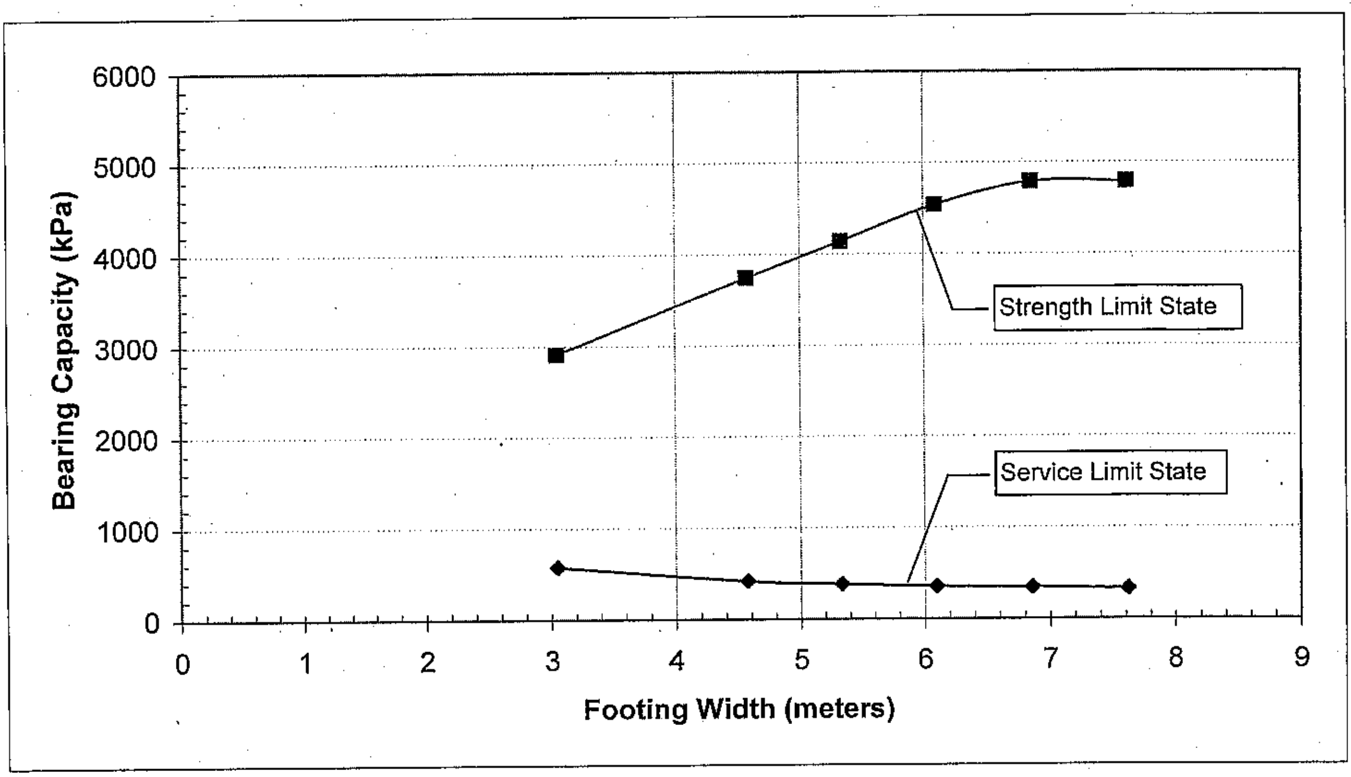
Figure 3: Generalized Geologic Profile

Bearing Capacity vs Footing Width
Pier 1

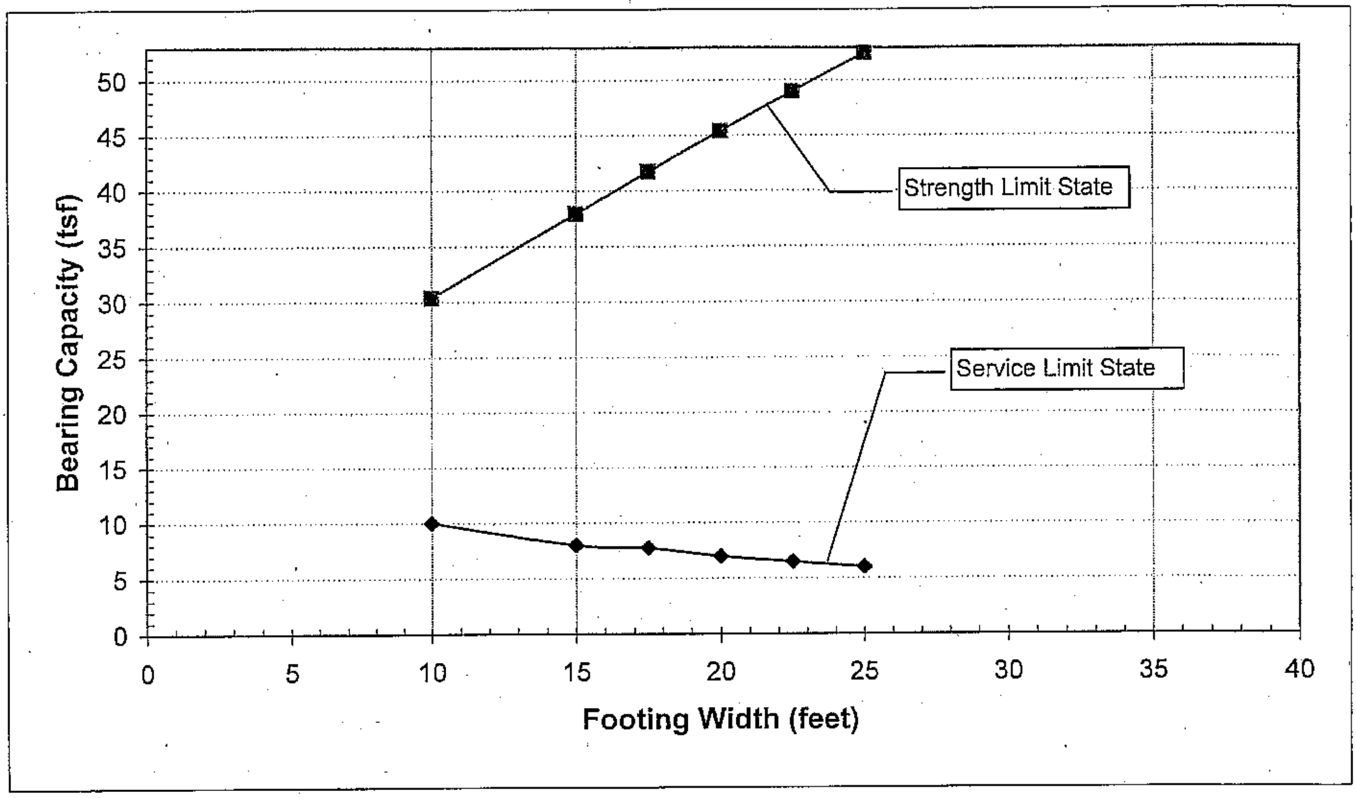


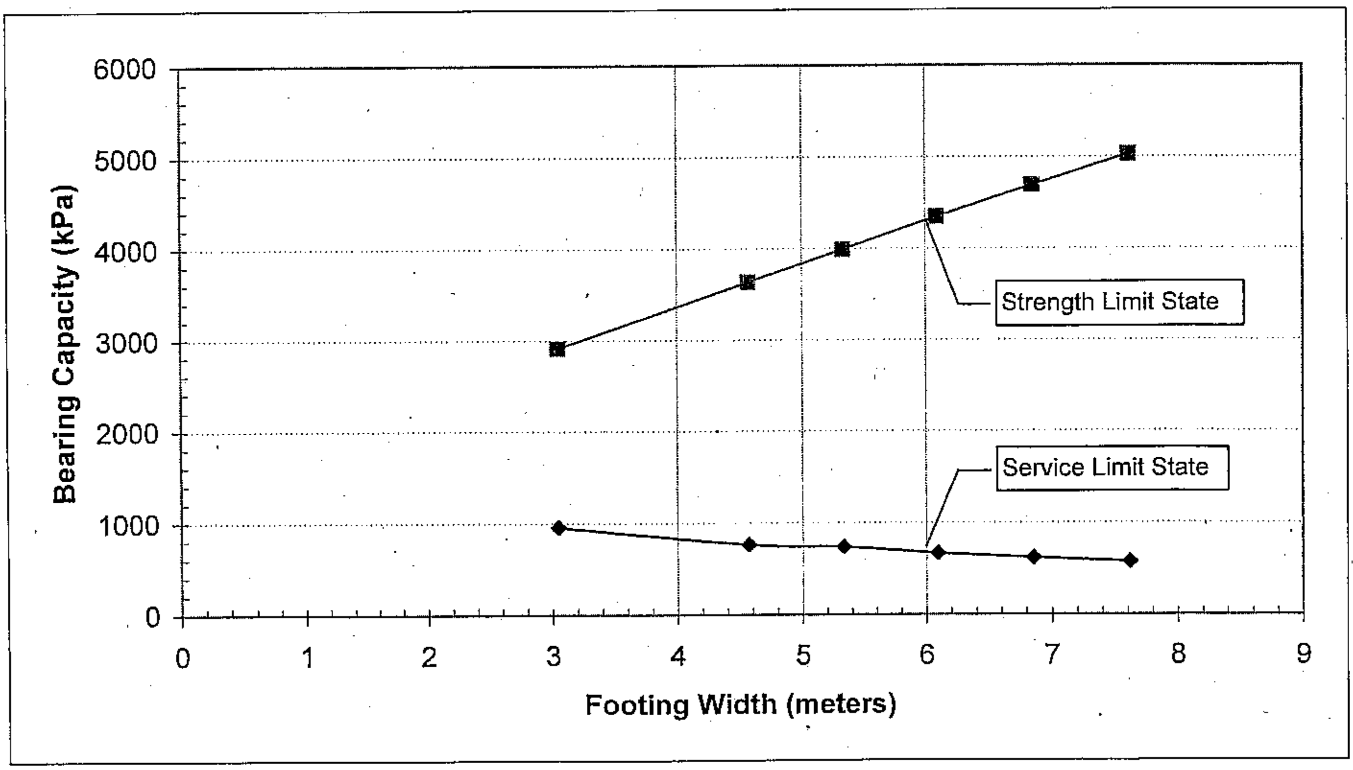


Note: Bearing capacities for Service Limit State are limited by 1-inch (25 mm) settlement

Figure 4

Bearing Capacity vs Footing Width
Pier 4



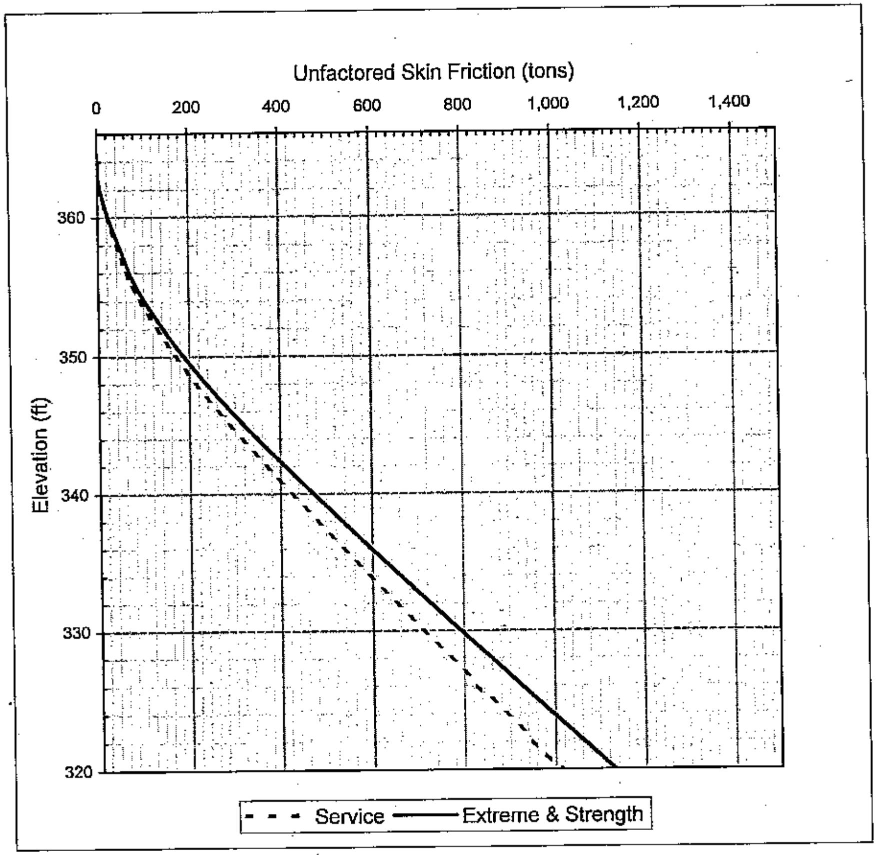


Note: Bearing capacities for Service Limit State are limited by 1-inch (25 mm) settlement

Figure 5

SR-12, Attalia Vicinity Four Laning Bridge BN & UP RR O'xing

Pier(s)	2	
Diameter	8.0	ft
Casing	yes	



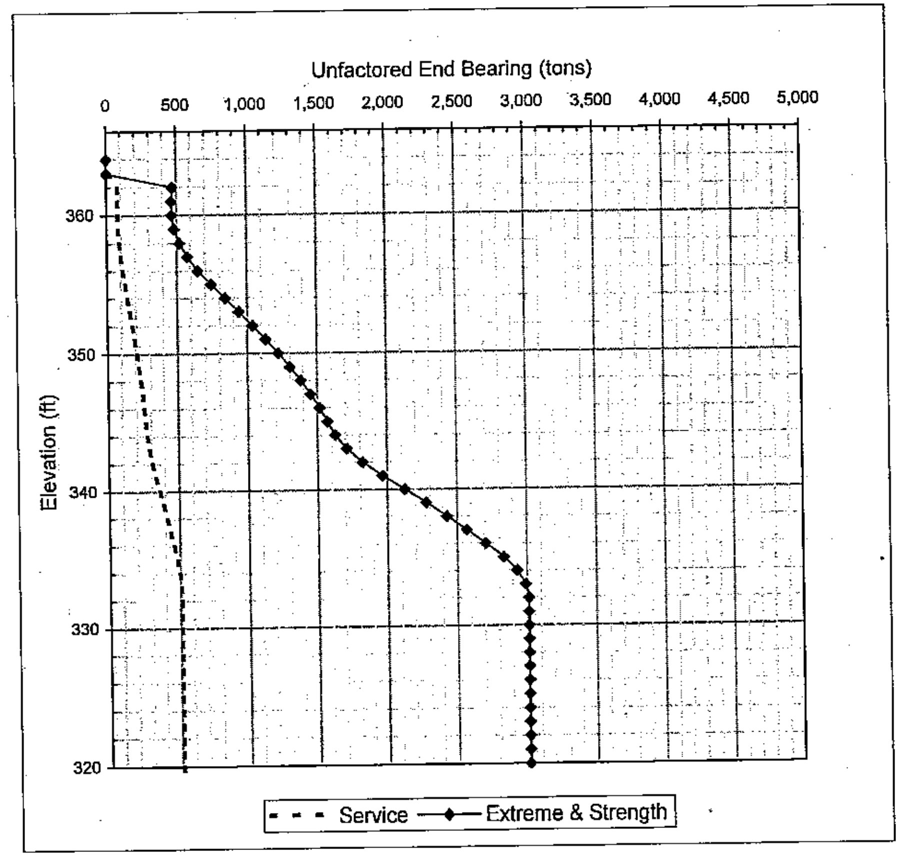
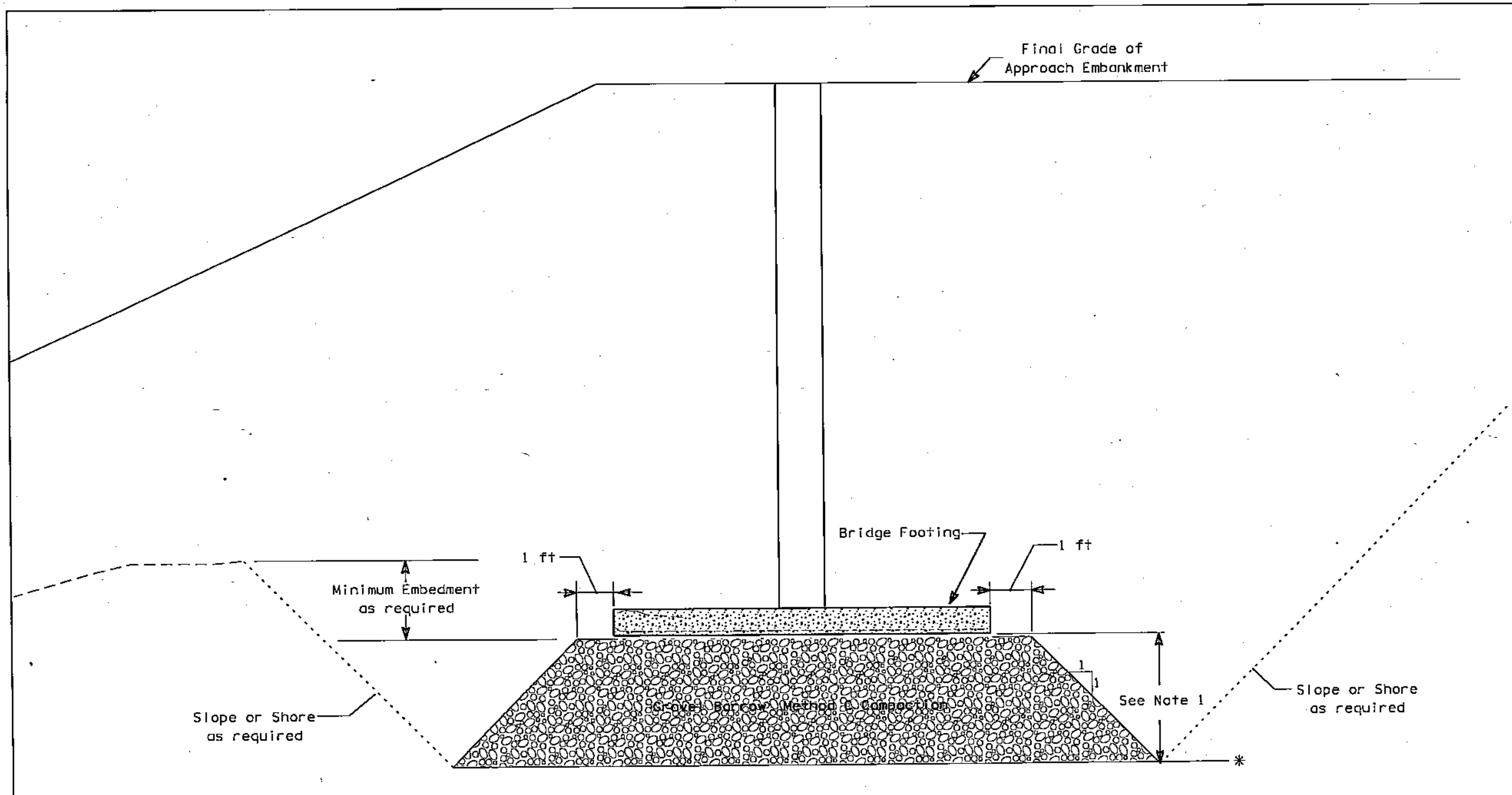


Figure 6



Notes:

1. Depth varies, see report
2. Bridge approach embankment should be constructed to full height before construction of bridge foundation.

JOB XL-2134 S.R. 12 C.S. ____ LAYOUT ____		
SR-12 Attalia Vicinity Bridge		
WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION MATERIALS BRANCH T.E. BAKER MATERIALS ENGINEER	DATE 12/2005 SCALE N.T.S. VERT. HORIZ. SHEET ___ OF ___ DRAWN BY DWG	

FIGURE 8: Overexcavation Detail

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APPENDIX B

S-SHAFT & P- Y PARAMETERS

SIL-Shaft Input Data

Bridge No. or Name
Pier No(s). 2 & 3
Ground Surface Elevation 365.0 (ft)

Layer	Soil Type	Layer Thickness (ft)	Btm. Elev. (ft)	Effective Unit Weight (pcf)	Friction[1] Angle (deg)	ε_{50} (%)	Liq.	Soil Cohesion (psf)	s_u at Top of Layer (psf)	s_u at Bottom of Layer (psf)	Rock Comp. Stgth (psf)	SPT Corrected Blowcounts (bpf)	Fines Content (%)	Angularity
1	Sand	15	350	130	36		No							
2	Sand	6	344	130	36		No							
3	Sand	8	336	68	40		No							
4	Sand	11	325	68	50		No							
5	Rock	6	319	105	57	0.004					775000			

[1] For Rock, this is the effective friction angle of the rock mass.

11/16/2005

P-y CURVE SOIL DATA
SR-12, Attalia Bridge 12/606
Piers 2 & 3

Reference Elevation (ft): 365

						STATIC ANALYSIS									
Soil Layer	Depth To Bottom of Layer	Bottom of Layer Eleavtion		Soil Type	Soil Profile Type (KSOIL)	Effective Unit Weight of Soil			Cohesion			Axial Strain $\varepsilon 50$	Friction Angle ϕ	Modulus of Subgrade Reaction	
	ft	m	ft			kN/m3	pci	pcf	kPa	psi	psf	(%)	(deg)	MN/m3	pci
1	15	105.46	350	SAND	4	20.4	0.075	130					36	43.4	160
2	21	103.63	344	SAND	5	20.4	0.075	130					36	43.6	161
3	29	102.41	336	SAND	4	10.7	0.039	68					40	67.8	250
4	40	99.06	325	SAND	4	10.7	0.039	68					50	81.3	300

APPENDIX C

FIELD EXPLORATION PROCEDURE AND LOGS

INTRODUCTION

Subsurface conditions in the project area were explored by rotary drilling and a laboratory testing program. The following describes the field exploration procedures, and provides all test hole data obtained in the field exploration program. Appendix D, provides all data obtained in the laboratory testing program.

FIELD EXPLORATION

The field exploration program for the project consisted of drilling 3 test borings. The information obtained during the field exploration was used to characterize the subsurface for discrete elements of project. The logs of the test borings should be included in the contract documents.

Test borings were completed using CME 45 and 850 drill rigs. The borings were drilled using wet rotary drilling method through HW and HQ casings.

Standard Penetration Tests (SPT), in general, were performed by WSDOT using a 51-mm (2-inch) outside diameter split spoon sampler. All of the drill rigs used a 623 kN CME safety autohammer for the SPT tests. During the test, a sample is obtained by driving the sampler 0.45 m (18-inch) into the soil with a hammer free-falling 0.76 m (30-inch). The number of blows required for each 0.15 m (6-inch) of penetration is recorded. The Standard Penetration Resistance or N-value of the soil is calculated as the number of blows required to drive the sampler the last 0.3 m (12-inch) of penetration. If a total of 50 blows is recorded within a 0.15 m (6-inch) interval, the test is terminated, and the blow count is recorded as 50 blows for the number of millimeters (inches) penetrated. The resistance or N-value provides a measure of the relative density of granular soils and the relative consistency of cohesive soils. It should be noted that the safety autohammer used at this site has been measured to have an efficiency of approximately 70 percent.

SPT testing, in general, was performed at 1.5 m (5-foot) intervals in the test borings. Disturbed soil samples from the SPT were visually classified in the field then submitted to the Materials Laboratory for more detailed classification and testing.

SPT values reported on the logs and profiles are the actual field measured SPT values. They have not been corrected for energy, silt content, rod weight and flexure, or overburden pressures.

TEST HOLE LOGS

Using the Unified Soil Classifications and supported by laboratory testing, test hole logs describe detailed information of materials and soils gathered from each test hole as it is advanced downward. The test hole logs indicate average depths where soil changes, graphically indicate blow counts, sample type and number, and if encountered ground water depth at the time of the drilling.

TEST BORING LOGS

Washington State
Department of Transportation

Test Boring Legend

Sampler Symbols

Standard Penetration Test
Oversized Penetration Test (Dames & Moore, California)
Shelby Tube
Piston Sample
Washington Undisturbed
Vane Shear Test
Core
Becker Hammer
Bag Sample

Well Symbols

Cement Surface Seal
Piezometer Pipe in Granular Bentonite Seal
Piezometer Pipe in Sand
Well Screen in Sand
Granular Bentonite Bottom Seal
Inclinometer Casing in Concrete Bentonite Grout

Laboratory Testing Codes

UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
UC	Unconfined Compression Test
DS	Direct Shear Test
CN	Consolidation Test
GS	Grain Size Distribution
MC	Moisture Content
SG	Specific Gravity
OR	Organic Content
DN	Density
AL	Atterberg Limits
PT	Point Load Compressive Test
SL	Slake Test
DG	Degradation
LA	LA Abrasion
HT	Hydrometer Test

Soil Density Modifiers

Gravel, Sand & Non-plastic Silt		Elastic Silts and Clay	
SPT Blows/ft	Density	SPT Blows/ft	Consistency
0-4	Very Loose	0-1	Very Soft
5-10	Loose	2-4	Soft
11-24	Medium Dense	5-8	Medium Stiff
25-50	Dense	9-15	Stiff
>50	Very Dense	16-30	Very Stiff
		31-60	Hard
		>60	Very Hard

Angularity of Gravel & Cobbles

Angular	Coarse particles have sharp edgesand relatively plane sides with unpolished surfaces.
Subangular	Coarse grained particles are similar to angular but have rounded edges.
Subrounded	Coarse grained particles have nearly plane sides but have well rounded corners and edges.
Rounded	Coarse grained particles have smoothly curved sides and no edges.

Soil Moisture Modifiers

Dry	Absence of moisture; dusty, dry to touch
Moist	Damp but no visible water
Wet	Visible free water

Soil Structure

Stratified	Alternating layers of varying material or color at least 6mm thick; note thickness and inclination.
Laminated	Alternating layers of varying material or color less than 6mm thick; note thickness and inclination.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, somtimes striated.
Blocky	Cohesive soil that can be broken down into smaller angular lumps which resist further breakdown.
Disrupted	Soil structure is broken and mixed. Infers that material has moved substantially - landslide debris.
Homogeneous	Same color and appearance throughout.

HCL Reaction

No HCL Reaction	No visible reaction.
Weak HCL Reaction	Some reaction with bubbles forming slowly.
Strong HCL Reaction	Violent reaction with bubbles forming imediately.

Degree of Vesicularity of Pyroclastic Rocks

Slightly Vesicular	5 to 10 percent of total
Moderately Vesicular	10 to 25 percent of total
Highly Vesicular	25 to 50 percent of total
Scoriaceous	Greater than 50 percent of total

Test Boring Legend

Grain Size

Fine Grained	< 1mm	Few crystal boundaries/grains are distinguishable in the field or with hand lens
Medium Grained	1mm to 5mm	Most crystal boundaries/grains are distinguishable with the aid of a hand lens.
Coarse Grained	> 5mm	Most crystal boundaries/grains are distinguishable with the naked eye.

Weathered State

Term	Description	Grade
Fresh	No visible sign of rock material weathering; perhaps slight discoloration in major discontinuity surfaces.	I
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than its fresh condition.	II
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as core stones.	III
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as discontinuous framework or as core stone.	IV
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil	All rock material is converted to soil. The mass structure and material fabric is destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Relative Rock Strength

Grade	Description	Field Identification	Uniaxial Compressive Strength approx
R1	Very Weak	Specimen crumbles under sharp blow from point of geological hammer, and can be cut with a pocket knife.	150-3500 psi
R2	Moderately Weak	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	3500-7500 psi
R3	Moderately Strong	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer.	7500-15000 psi
R4	Strong	Specimen breaks with one firm blow from the hammer end of a geological hammer.	15000-350000 psi
R5	Very Strong	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 30000 psi

Discontinuities

Spacing

Very Widely	Greater than 3 m
Widely	1 m to 3 m
Moderately	0.3 m to 1 m
Closely	50 mm to 300 mm
Very Closely	Less than 50 mm

RQD (%)

$$\frac{100(\text{length of core in pieces} > 100\text{mm})}{\text{Length of core run}}$$

Condition

Excellent	Very rough surfaces, no separation, hard discontinuity wall
Good	Slightly rough surfaces, separation less than 1 mm, hard discontinuity wall.
Fair	Slightly rough surfaces, separation greater than 1 mm, soft discontinuity wall.
Poor	Slickensided surfaces, or soft gouge less than 5 mm thick, or open discontinuities 1 to 5 mm.
Very Poor	Soft gouge greater than 5 mm thick, or open discontinuities greater than 5 mm.

Fracture Frequency (FF) is the average number of fractures per 300 mm of core.
Does not include mechanical breaks caused by drilling or handling.

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-22755

HOLE No. H-1-05

Sheet 1 of 3

Job No. XL-2134 | SR 12 | Elevation 365.2 ft (111.3 m)

Project SR12 Attalia vicinity Bridge

Driller Thomas Harvey | Lic# 2599

Site Address SR 12 near milepost 304.

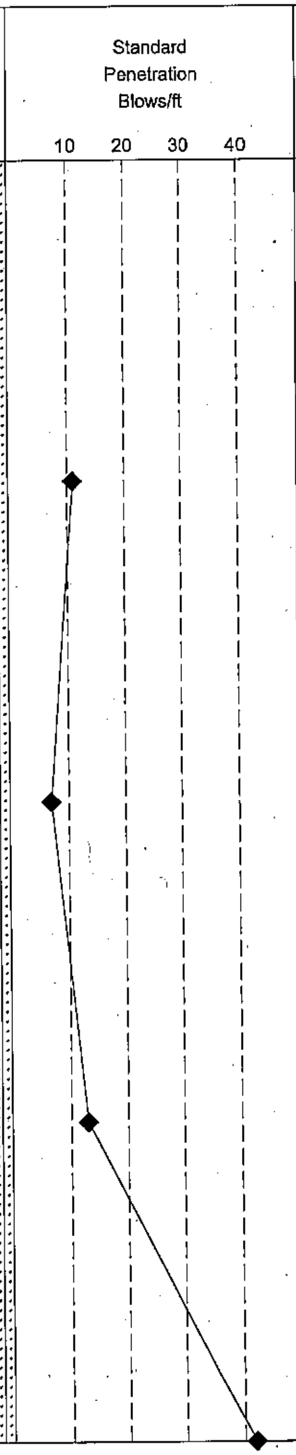
Inspector Don Nebgen

Start March 23, 2005 | Completion March 23, 2005 | Well ID# | Equipment CME 45 w/ autohammer

Station 307+00 | Offset Centerline | Casing 4x51 | Method Wet Rotary

Northing 614056.1877 | Easting 2370527.3446 | Latitude | Longitude

County Walla Walla | Subsection SE-SE | Section 10 | Range 31 EWM | Township 7



Depth (ft)	Meters (m)	Profile	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5			5 6 5 (11)		D-1		Silty SAND, fine, medium dense, brown, dry, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
10	3		3 4 3 (7)		D-2		Silty SAND, loose, brown, moist, Stratified, no HCl reaction, interbedded strata fine sand and sandy silt. Length Recovered 1.0 ft, Length Retained 1.0 ft		
15			5 6 7 (13)		D-3		Silty SAND, medium dense, brown, moist, Laminated, no HCl reaction, colored bedding. Length Recovered 1.5 ft, Length Retained 1.2 ft		
20	6								

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22755

HOLE No. H-1-05

Sheet 2 of 3

Job No. XL-2134 SR 12 Elevation 365.2 ft (111.3 m)

Project SR12 Attalia vicinity Bridge

Driller Thomas Harvey Lic# 2599

Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater
	7	14 19 23 (42)	D-4		Silty SAND, dense, brown, moist, Stratified, no HCl reaction, stratifed colors. Length Recovered 1.5 ft, Length Retained 1.2 ft	
25	8	10 20 31 (51)	D-5	GS MC	ML, MC=28% Sandy SILT, very dense, brown, moist, Laminated, no HCl reaction, laminated coloring. Length Recovered 1.5 ft, Length Retained 1.2 ft	
30	9, 10	11 24 50 (74)	D-6	GS MC	SM, MC=21% Silty SAND, very dense, brown, wet, Laminated, no HCl reaction, Laminateed sands and silt to 31 feet, well graded sand and gravel below 31 feet. Length Recovered 1.4 ft, Length Retained 1.2 ft	∇ 3/23/05
35	11	35 32 30 (62)	D-7		Well graded GRAVEL with sand, subrounded, very dense, dark brown, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft	
		RQD 95 FF 1	C-8		BASALT, dark grey, fine grained, fresh, strong rock, no HCl reaction. Discontinuities are closely spaced and in execellent condition, Percent Recovered 100.0%	
40	12, 13	RQD 20 FF 3	C-9		BASALT, dark grey, fine grained, fresh, strong rock, no HCl reaction. Discontinuities are closely spaced and in execellent condition, Percent Recovered 100.0%	
45						

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22755

HOLE No. H-1-05

Job No. XL-2134 SR 12 Elevation 365.2 ft (111.3 m)

Sheet 3 of 3

Project SR12 Attalia vicinity Bridge

Driller Thomas Harvey Lic# 2599

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			RQD 90 FF 2		C-10		BASALT, dark grey, fine grained, fresh, strong rock, no HCl reaction. Discontinuities are closely spaced and in exececllent condition, Percent Recovered 100.0%		
50	15									
	16							End of test hole boring at 51 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
55	17									
60	18									
	19									
65	20									
70	21									

SOIL XL-2134 SR 12 WIDENING ATTALIA BRIDGE.GPJ SOIL.GDT 12/7/05,2:12:33 P12

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22755

HOLE No. H-2-05

Sheet 1 of 3

Job No. XL-2134 SR 12 Elevation 364.9 ft (111.2 m)

Driller Vince Johnson Lic# 2532

Project SR12 Attalia vicinity Bridge

Site Address SR-12 Vic. MP 304

Inspector Brian Hilts

Start April 5, 2005 Completion April 5, 2005 Well ID#

Equipment CME 850 w/ autohammer

Station 308+88 Offset 3ft Rt. Casing 6"x37' 4"x58.5'

Method Wet Rotary

Northing 613894.9956 Easting 2370624.1823 Latitude

Longitude

County Walla Walla Subsection SE1/4 NE1/4 Section 10 Range 31 EWM Township 7

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				4 6 7 (13)		D-1		Silty SAND, medium dense, light brownish gray, dry, Homogeneous, HCl reaction not tested Length Recovered 1.1 ft, Length Retained 1.1 ft		
				4 3 4 (7)		D-2		Silty SAND, loose, brown, wet, Homogeneous, HCl reaction not tested, The top .3' was moist, the middle .6' was wet, and the bottom .3' was dry. Length Recovered 1.2 ft, Length Retained 1.2 ft		
				5 7 8 (15)		D-3		Silty SAND, medium dense, grayish brown, moist, Homogeneous, HCl reaction not tested, At 18.5' we encountered some gravels. Length Recovered 1.3 ft, Length Retained 1.3 ft		
				10 14		D-4		Silty SAND, dense, dark gray, wet, Homogeneous, HCl reaction not tested, Water table area. At 20.5' drilling		

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-22755

HOLE No. H-2-05

Sheet 2 of 3

Job No. XL-2134 SR 12 Elevation 364.9 ft (111.2 m)

Project SR12 Attalia vicinity Bridge

Driller Vince Johnson Lic# 2532

Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater
		14 (28)			smoothed out. Length Recovered 0.8 ft, Length Retained 0.8 ft	
					4/5/05	∇
	7					
25		15 17 17 (34)	D-5	GS MC	SM, MC=23% Silty SAND, dense, dark gray, wet, Homogeneous, HCl reaction not tested Length Recovered 1.3 ft, Length Retained 1.3 ft	
	8					
30	9	15 20 20 (40)	D-6	GS MC	SP-SM, MC=22% Poorly graded SAND with silt, dense, grayish brown, moist, Homogeneous, HCl reaction not tested, At 31.5' we encountered gravels and the soil became denser demonstrated by drilling. Length Recovered 1.3 ft, Length Retained 1.3 ft	
	10					
35		19 31 43 (74)	D-7		Well graded SAND with gravel, very dense, dark gray, wet, Homogeneous, HCl reaction not tested Length Recovered 1.3 ft, Length Retained 1.3 ft	
	11		C-8		Well graded GRAVEL, subrounded, very dense, dark gray, wet, Homogeneous, HCl reaction not tested Length Recovered 1.3 ft, Length Retained 1.3 ft	
	12					
40		50/2" (50/2") RQD 58 FF 2.9	D-9 C-10		Well graded GRAVEL, angular, very dense, very dark gray, wet, Homogeneous, HCl reaction not tested, (BASALT) Length Recovered 0.2 ft, Length Retained 0.2 ft BASALT, medium gray, fine grained, fresh, strong rock, HCl reaction not tested. Discontinuities are very closely spaced and in fair condition, with some soil infill., Percent Recovered 100.0%	
	13					
45						

Standard Penetration Blows/ft: 10 20 30 40

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22755

HOLE No. H-2-05

Job No. XL-2134 SR 12 Elevation 364.9 ft (111.2 m)

Sheet 3 of 3

Project SR12 Attalia vicinity Bridge

Driller Vince Johnson Lic# 2532

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			RQD 66 FF 2		C-11		BASALT, medium gray, fine grained, fresh, strong rock, HCl reaction not tested. Discontinuities are closely spaced and in good condition, Percent Recovered 100.0%		
50	15			RQD 43 FF 2.2		C-12		BASALT, medium gray, fine grained, fresh, strong rock, HCl reaction not tested. Discontinuities are very closely spaced and in good condition, Percent Recovered 100.0%		
	16									
55	17							End of test hole boring at 55 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. Bailed the to 21.5' and was not making any furhter progress. Water table area.,		
	18									
60	19									
65	20									
	21									
70										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22755

HOLE No. H-3-05

Sheet 1 of 3

Job No. XL-2134 SR 12 Elevation 365.2 ft (111.3 m)

Project SR12 Attalia vicinity Bridge

Driller Vince Johnson Lic# 2532

Site Address SR-12 vic. mp 304

Inspector Brian Hilts

Start March 31, 2005 Completion March 31, 2005 Well ID#

Equipment CME 850 w/ autohammer

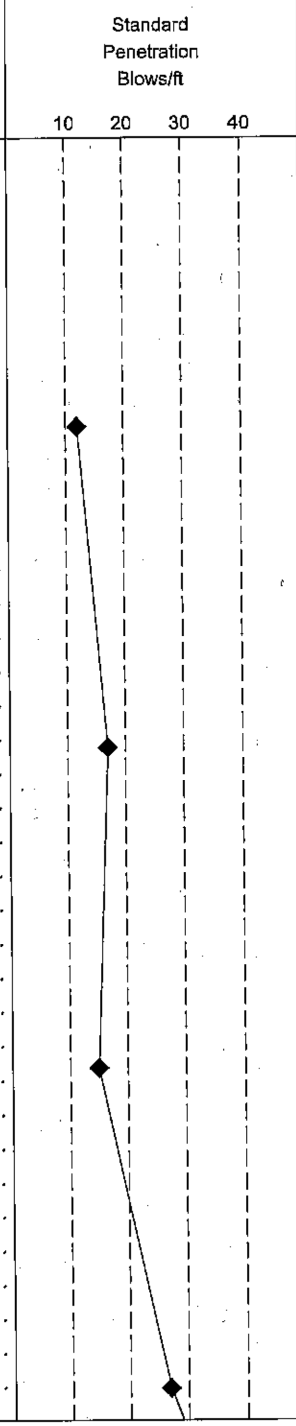
Station 310+73 Offset 3ft Rt. Casing 6"x42' 4"x53.3'

Method Wet Rotary

Northing 613737.93 Easting 2370721.949 Latitude

Longitude

County Walla Walla Subsection SE1/4 NE1/4 Section 10 Range 31 EWM Township 7



Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample No. (Tube No.)	Lab Tests	Description of Material
5	1–2	4 6 6 (12)	D-1		SILT with sand, medium dense, gray, dry, Homogeneous, HCl reaction not tested, From 0- 2' we encountered gravels. Length Recovered 1.1 ft, Length Retained 1.1 ft
10	3	5 7 10 (17)	D-2		SILT with sand, medium dense, gray, dry, Homogeneous, HCl reaction not tested Length Recovered 1.2 ft, Length Retained 1.2 ft
15	4–5	6 7 8 (15)	D-3		SILT with sand, medium dense, light brownish gray, dry, Stratified, HCl reaction not tested, The top .4' was (SP) sand and the bottom .8' was silty fine sand. Length Recovered 1.2 ft, Length Retained 1.2 ft
20	6	8	D-4	GS	ML, MC=24%

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-22755
HOLE No. H-3-05
Sheet 2 of 3

Job No. XL-2134 SR 12 Elevation 365.2 ft (111.3 m)

Project SR12 Attalia vicinity Bridge

Driller Vince Johnson Lic#. 2532

Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater
		11 16 (27)		MC	SILT with sand, dense, brown, moist, Stratified, HCl reaction not tested, Stratified with sandy silt and (SP) sand. (note) we encountered gravels and cobbles at 16' to 17.5' demonstrated by drilling. Length Recovered 1.2 ft, Length Retained 1.2 ft	
	7					3/31/05 ∇
25		16 21 27 (48)	D-5		SILT with sand, dense, brown, moist, Stratified, HCl reaction not tested, Stratified with dark gray sand. Length Recovered 1.3 ft, Length Retained 1.3 ft	
	8					
30	9	13 20 27 (47)	D-6		SILT with sand, dense, brown, moist, Stratified, HCl reaction not tested, The top .5' was silty very fine sand and the bottom .6' was (SP) sand grayish brown in color. At 33' we encountered a few gravels. Length Recovered 1.1 ft, Length Retained 1.1 ft	
	10					
35		12 41 50 (91)	D-7		SILT with sand, very dense, grayish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 1.2 ft, Length Retained 1.2 ft	
	11		C-8		SILT with sand, very dense, dark gray, wet, Stratified, HCl reaction not tested, Fines washed out. Length Recovered 1.0 ft, Length Retained 1.0 ft	
	12					
40		10 22 30 (52)	D-9		SILT with sand, very dense, dark gray, wet, Homogeneous, HCl reaction not tested Length Recovered 0.6 ft, Length Retained 0.6 ft	
	13	RQD 69 FF 1	C-10		BASALT, medium gray, fine grained, fresh, strong rock, HCl reaction not tested. Discontinuities are closely spaced and in good condition, Percent Recovered 100.0%	
45						

Standard Penetration Blows/ft: 10 20 30 40 (>> marks at 35 ft and 40 ft)

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22755

HOLE No. H-3-05

Sheet 3 of 3

Job No. XL-2134 SR 12 Elevation 365.2 ft (111.3 m)

Project SR12 Attalia vicinity Bridge

Driller Vince Johnson Lic# 2532

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			RQD 68 FF 2		C-11		BASALT, medium gray, fine grained, fresh, very strong rock, HCl reaction not tested. Discontinuities are closely spaced and in good condition, Percent Recovered 100.0%		
50	15			RQD 81 FF 1		C-12		BASALT, mediun gray, fine grained, fresh, very strong rock, HCl reaction not tested. Discontinuities are closely spaced and in good condition, Percent Recovered 100.0%		
55	16									
	17							End of test hole boring at 55.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. We bailed the hole to 54.5', we pulled the casing and the hole stayed open to 46', and the water table was at 23.5'.		
60	18									
65	19									
	20									
70	21									

SOIL XL-2134 SR 12 WIDENING ATTALIA BRIDGE.GPJ SOIL.GDT 12/7/05,2:12:41 P12

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-22755

HOLE No. H-4-05

Sheet 1 of 3

Job No. XL-2134 SR 12 Elevation 376.4 ft (114.7 m)

Project SR12 Attalia vicinity Bridge

Driller Vince Johnson Lic# 2532

Site Address SR-12 vic. mp 304

Inspector Brian Hilts

Start March 30, 2005 Completion March 30, 2005 Well ID#

Equipment CME 850 w/ autohammer

Station 312+80 Offset Centerline Casing 6"x52' 4"x63.5'

Method Wet Rotary

Northing 613563.7448 Easting 2370833.8884 Latitude

Longitude

County Walla Walla Subsection SE1/4 NE1/4 Section 10 Range 31 EWM Township 7

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	1									
5				2 3 3 (6)		D-1		Silty SAND, loose, light brownish gray, dry, Homogeneous, HCl reaction not tested Length Recovered 0.9 ft, Length Retained 0.9 ft		
	2									
10	3			3 4 6 (10)		D-2	GS MC	SM, MC=15% Silty SAND, loose, light brownish gray, dry, Stratified, HCl reaction not tested, The top .5' was very fine sand with a trace of silt, and the bottom .5' was (SW) sand very dark gray in color. We encountered gravels at 11.5' to 12.4' demonstrated by drilling. Length Recovered 1.0 ft, Length Retained 1.0 ft		
	4									
15			>>	14 26 30 (56)		D-3	GS MC	SM, MC=14% Silty SAND, very dense, light brownish gray, dry, Homogeneous, HCl reaction not tested Length Recovered 1.3 ft, Length Retained 1.3 ft		
	5									
20	6		>>	13		D-4		Silty SAND, very dense, light brownish gray, dry,	∇	

SOIL XL-2134 SR 12 WIDENING ATTALIA BRIDGE.GPJ SOIL.GDT 12/7/05,2:12:43 P12

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22755

HOLE No. H-4-05

Sheet 2 of 3

Job No. XL-2134 SR 12 Elevation 376.4 ft (114.7 m)

Project SR12 Attalia vicinity Bridge

Driller Vince Johnson Lic# 2532

Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample No. (Tube No.)	Lab Tests	Description of Material
		25 33 (58)			Homogeneous, HCl reaction not tested, At 24' we encountered a few gravels demonstrated by drilling. Length Recovered 1.1 ft, Length Retained 1.1 ft 3/30/05
	7				
25		>> 21 31 35 (66)	D-5		Silty SAND, very dense, gray, dry, Homogeneous, HCl reaction not tested, The top 1' was moist with a trace of reddish brown organics, and the bottom .5' was dry. Length Recovered 1.3 ft, Length Retained 1.3 ft
	8				
30	9	>> 17 25 30 (55)	D-6	GS MC	ML, MC=28% SILT, very dense, brown, moist, Stratified, HCl reaction not tested, Stratified with very fine sandy silt. Length Recovered 1.5 ft, Length Retained 1.5 ft
	10				
35		>> 21 29 37 (66)	D-7		Poorly graded SAND, very dense, dark gray, moist, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.5 ft
	11				
	12				
40		10 20 28 (48)	D-8		Poorly graded SAND, dense, brown, moist, Stratified, HCl reaction not tested, The top .5' was sandy silt, the middle .5' was silty sand, and the bottom .2' was (SP) sand grayish brown in color. mAt 43' we encountered a few gravels demonstrated by drilling. Length Recovered 1.2 ft, Length Retained 1.2 ft
	13				
45		45	D-9		Poorly graded SAND with gravel, very dense, grayish

Standard Penetration Blows/ft: 10 20 30 40

SOIL XL-2134 SR 12 WIDENING ATTALIA BRIDGE.GPJ SOIL.GDT 12/7/05,2:12:43 P12

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-22755

HOLE No. H-4-05

Job No. XL-2134 SR 12 Elevation 376.4 ft (114.7 m)

Sheet 3 of 3

Project SR12 Attalia vicinity Bridge

Driller Vince Johnson Lic# 2532

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			50/5" (50/5")				brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.9 ft, Length Retained 0.9 ft		
50	15			50/0 (50/0")		D-10 C-11		No Recovery Well graded GRAVEL with sand, very dense, grayish brown, moist, Homogeneous, recovery 3.5'. Modifier: cobbles. (note) We encountered BASALT at 54.5'. The last 1' was BASALT.		
55	16, 17			RQD 26 FF 5		C-12		BASALT, medium gray, fine grained, fresh, strong rock, HCl reaction not tested. Discontinuities are very closely spaced and in fair condition, The water table inside the casing after drilling was at 20 ft., Percent Recovered 100.0%		
60	18, 19							End of test hole boring at 60.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
65	20									
70	21									

APPENDIX D

LABORATORY TESTING

SUMMARY OF LABORATORY TESTING

Laboratory testing was performed on selected samples from the field exploration program. The samples are grouped into two categories, disturbed and undisturbed. Disturbed samples are those that were obtained during the Standard Penetration Test while undisturbed samples are those samples that were obtained using the WSDOT sampler.

All disturbed soil samples were visually examined and then grouped together based on particle size distribution, consistency, and color. Once groups of samples were established that had similar characteristics, a minimum of one sample per group was tested. The testing consisted of performing particle size analyses, determining the liquid limit if applicable, and determining the plastic limit and plasticity index if applicable. The tests were done in accordance with AASHTO T-88, T-89, and T-90 guide specifications respectively. After the testing was complete, the samples were classified using the Unified Soil Classification System (USCS).

Selected undisturbed samples were also tested using the aforementioned procedures once the consolidation testing was completed. Three consolidation tests were performed to evaluate compressibility characteristics for the embankment fill widening. The tests were done in accordance with AASHTO T-216.

LABORATORY SUMMARY SHEETS

Job No.	XL-2134	Date	June 1, 2005
Hole No.	H-1-05	Sheet	1 of 1
Project	SR12 Attalia vicinity Bridge		

Laboratory Summary

Washington State Department of Transportation

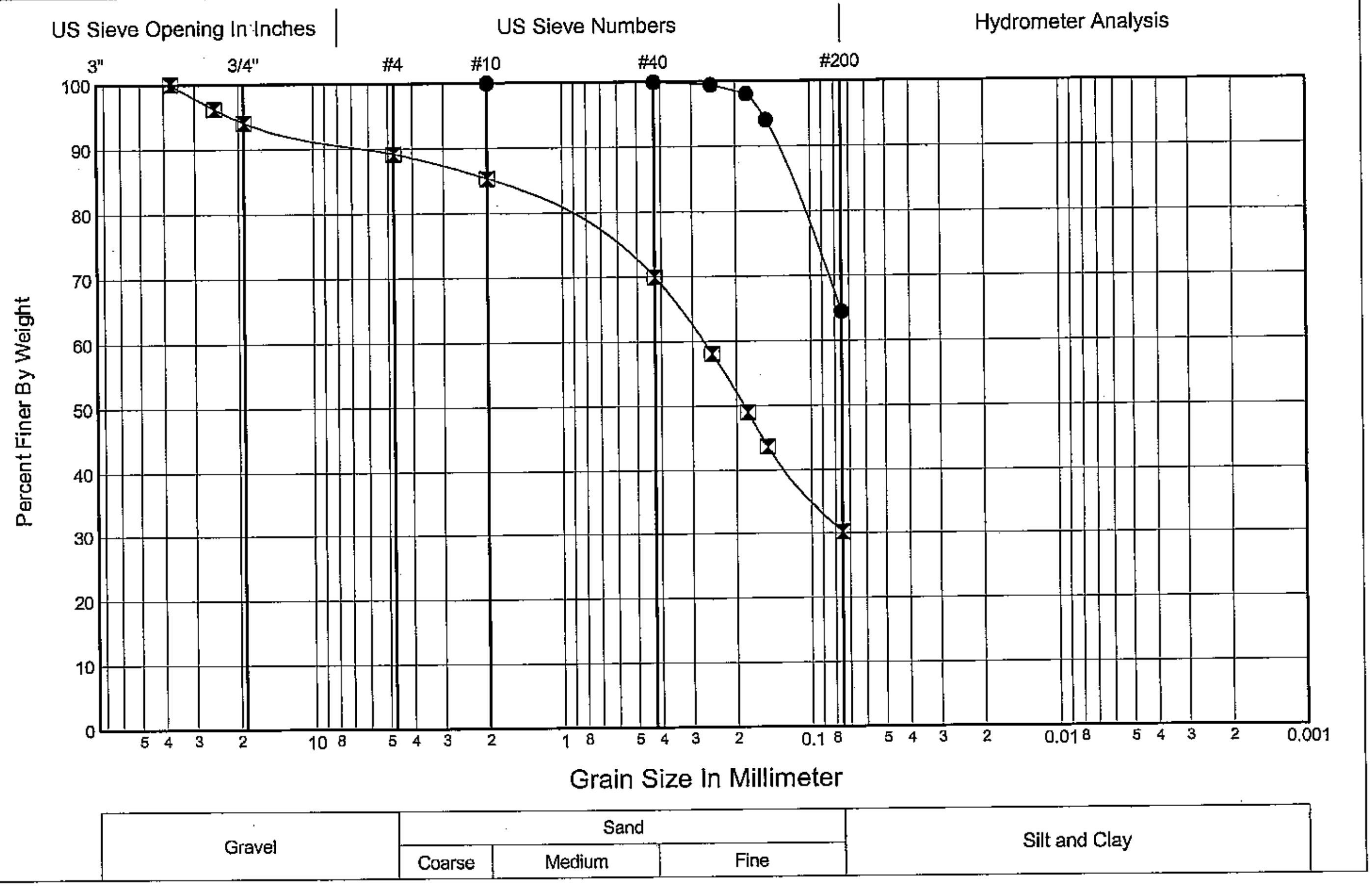
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	25.0	7.62	D-5	ML	See Boring Log	SANDY SILT	28			
⊠	30.0	9.14	D-6	SM	See Boring Log	SILTY SAND	21			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	35.5	64.5		
⊠	10.8	59.0	30.2		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠	0.272	0.19			



Job No. **XL-2134**
Hole No. **H-2-05**
Project **SR12 Attalia vicinity Bridge**

Date **June 1, 2005**
Sheet **1** of **1**

Laboratory Summary

Washington State Department of Transportation

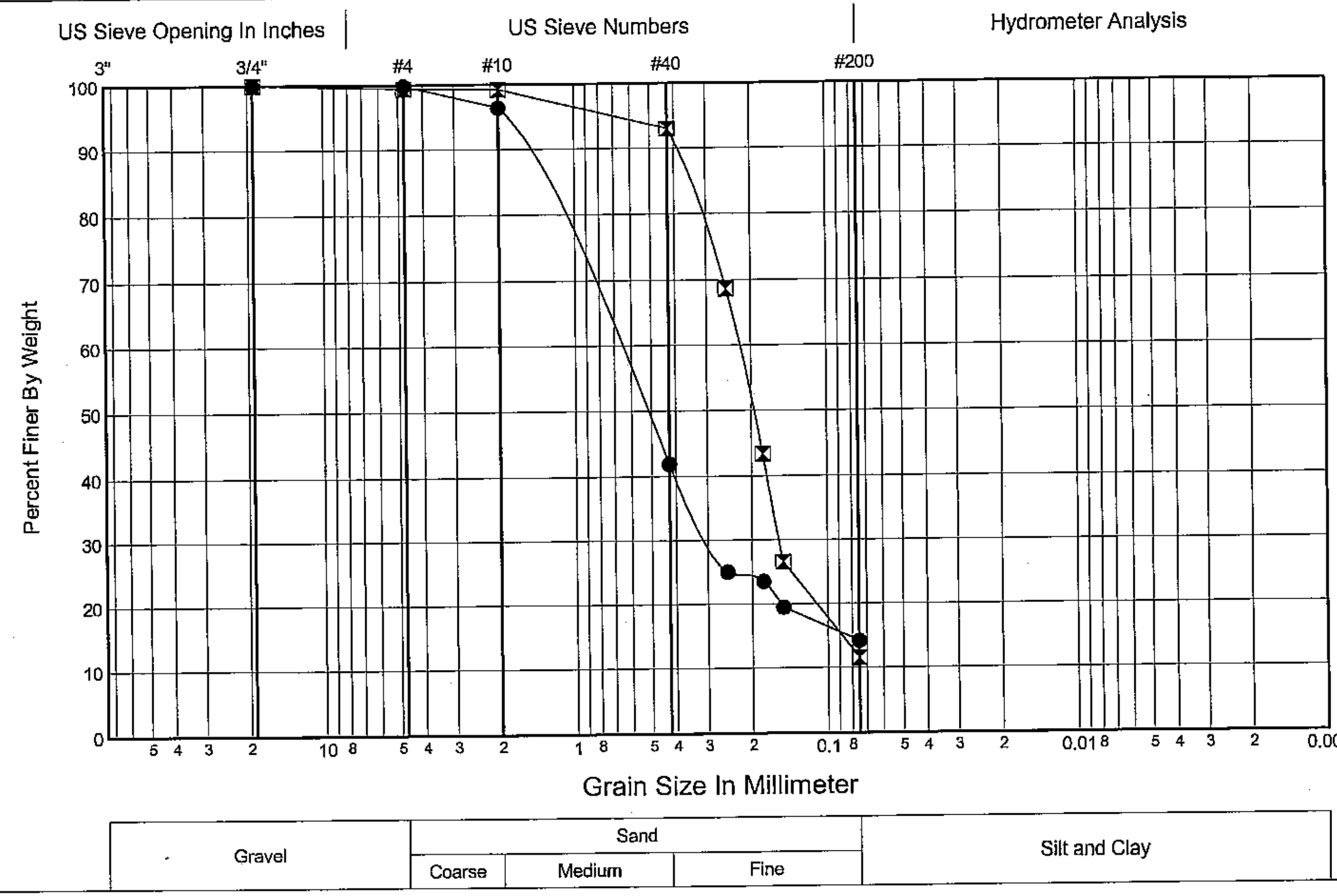
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	24.0	7.32	D-5	SM	See Boring Log	SILTY SAND	23			
⊠	29.0	8.84	D-6	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	22			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.2	85.7	14.2		
⊠	0.6	87.9	11.5	1.6	3.2

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.711	0.53	0.29	0.15	
⊠	0.223	0.20	0.16	0.11	



Job No. **XL-2134**
Hole No. **H-3-05**
Project **SR12 Attalia vicinity Bridge**

Date **June 1, 2005**
Sheet **1** of **1**

Laboratory Summary

Washington State
Department of Transportation

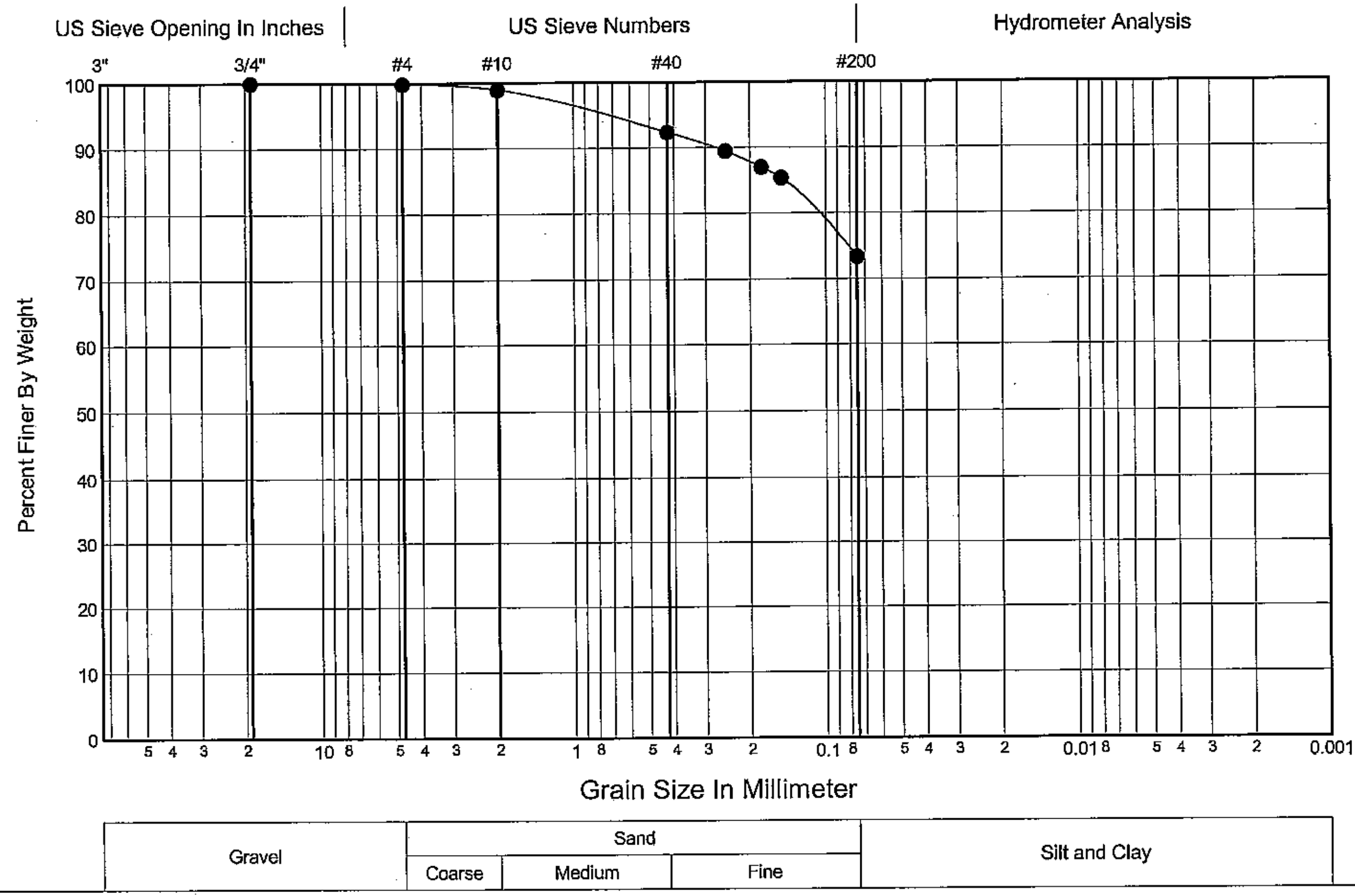
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	**19.5**	**5.94**	**D-4**	**ML**	**See Boring Log**	**SILT with SAND**	**24**			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	**0.2**	**26.5**	**73.4**		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					



Job No. **XL-2134**
Hole No. **H-4-05**
Project **SR12 Attalia vicinity Bridge**

Date **June 1, 2005**
Sheet **1** of **1**

Laboratory Summary

Washington State Department of Transportation

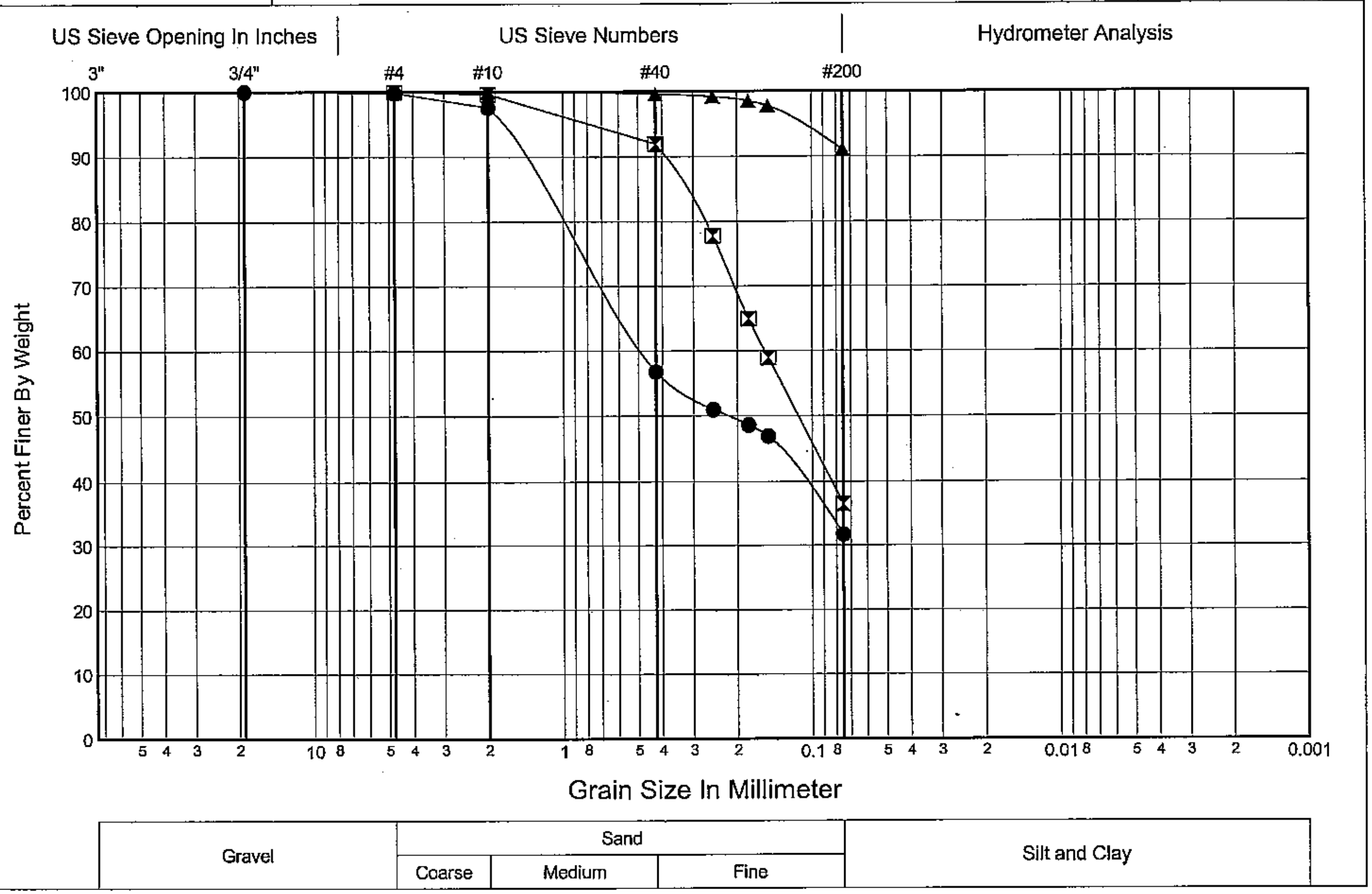
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	9.5	2.90	D-2	SM	See Boring Log	SILTY SAND	15			
⊠	14.5	4.42	D-3	SM	See Boring Log	SILTY SAND	14			
▲	29.5	8.99	D-6	ML	See Boring Log	SILT	28			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.2	68.1	31.7		
⊠	0.0	63.5	36.5		
▲	0.0	9.0	91.0		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.480	0.22			
⊠	0.155	0.11			
▲					



WASHINGTON STATE DEPARTMENT OF TRANSPORTATION - MATERIALS LABORATORY
PO BOX 167 OLYMPIA, WA. 98507-0167/1655 SO. 2ND AVE TUMWATER, WA. 98512

Physical Testing Section
PCC Compressive Strength Test Report
Test Method AASHTO T 22

Work Order No. **XL2134**
Lab ID No. **J-0000331499**

Transmittal No. **517654**
Bid Item No.
Org. Code
F.A. No.

Date Received: **10/13/2005**
S.R. No.: **12**
County: **WALLA WALLA**
Section: **ATTALIA VIC BRIDGE WIDENING**
Contractor:

==

Cement: Type: Mill Test No.:

Mixing Plant Location: Cert. No.:

Admixtures

Air Entrainment Per 100 Wt.:
Water Reducer Per 100 Wt.:

Water Per 100 Wt.:
Water/Cement Ratio W/C :

Mix Data

Cement lb/cy:
Gravel Source:
Sand Source:
Approx. Slump:
Percent of Air:

Class:
Date Made: Date Tested: **10/18/2005** Test Age: Days

Concrete Placement Location: **H-3-05 / 42.5' - 47.4'**

Cylinder No.	1	2	3
Diameter (in.)	2.41	2.41	2.41
Cross-Section Area (sq. in.)	4.56	4.56	4.56
Original Length (in.)	5.08	5.04	4.88
Original Weight (lbs.)	2.35	2.30	2.27
lbs/cf	175.3	172.9	176.3
L/D Ratio	2.11	2.09	2.02
Correction Factor	1.00	1.00	1.00
Maximum Load (lbf)	77,494	40,259	24,538
Compressive Strength (psi)	16,990	8,830	5,380
Fracture Type	Cone	Cone	Shear

Avg. Comp Strength (psi) **10,400**

==

Distribution:

Materials File X
Region Construction 45 X
Project Engineer:
SA'UD TAYEH X(2)

Results: **INFORMATIONAL**
Remarks:

THOMAS E. BAKER, P.E.
MATERIALS ENGINEER
Donald Brouillard By:
Date: 11/01/2005
Phone: (360)709-5446

T46E- T46H- T46Y-
T46N- **3.0** T46X-

cylinder.dfr 3/02

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION - MATERIALS LABORATORY
PO BOX 167 OLYMPIA, WA. 98507-0167/1655 SO. 2ND AVE TUMWATER, WA. 98512

Physical Testing Section
PCC Compressive Strength Test Report
Test Method AASHTO T 22

Work Order No. XL2134
Lab ID No. J-0000331500

Transmittal No. 517654
Bid Item No.
Org. Code
F.A. No.

Date Received: 10/13/2005
S.R. No.: 12
County: WALLA WALLA
Section: ATTALIA VIC BRIDGE WIDENING
Contractor:

==

Cement: Type: Mill Test No.:

Mixing Plant Location: Cert. No.:

Admixtures

Air Entrainment Per 100 Wt.:
Water Reducer Per 100 Wt.:

Water Per 100 Wt.:
Water/Cement Ratio W/C :

Mix Data

Cement lb/cy:
Gravel Source:
Sand Source:
Approx. Slump:
Percent of Air:

Class:
Date Made: Date Tested: 10/18/2005 Test Age: Days

Concrete Placement Location: H-3-05 51.6'-52.3' / H-2-05 47.9'-48.55'

Cylinder No.	4	5
Diameter (in.)	2.40	2.40
Cross-Section Area (sq. in.)	4.52	4.52
Original Length (in.)	5.03	4.95
Original Weight (lbs.)	2.40	2.28
lbs/cf	182.4	176.1
L/D Ratio	2.10	2.06
Correction Factor	1.00	1.00
Maximum Load (lbf)	95,828	60,682
Compressive Strength (psi)	21,200	13,430
Fracture Type	Cone	Cone

Avg. Comp Strength (psi) 17,315

==

Distribution:

Materials File X
Region Construction 45 X
Project Engineer:
SA'UD TAYEH X(2)

Results: INFORMATIONAL
Remarks:

THOMAS E. BAKER, P.E.
MATERIALS ENGINEER
Donald Brouillard By:
Date: 11/01/2005
Phone: (360)709-5446

T46E- T46H- T46Y-
T46N- 2.0 T46X-

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